TECHNICAL ANALYSIS BASED ON ELLIOTT WAVE PRINCIPLE FOR FX TRADE

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Abstract

The prime objective of this Project is to predict the market movement of the JPY/USD and, if possible, to develop a profitable trading model. Currently, there are two main schools of thoughts in predicting the market movement, namely the fundamental analysis and the technical analysis. In this Project, however, we will focus only on the Technical Analysis, in particular, the Elliott's Wave Principle (the "Wave Principle"). Our prediction will be solely based on historic price movement.

In its simplest form, the Wave Principle depicts that whenever there is an up-trend, there will be a down-trend follows. All trends of price movements will however go along with Time until their corrections. In addition, the amplitude of corrections will be at the Fibonacci Ratios. Based on these principles, we developed some trading rules.

a. During a trend, trade along the trend.

b. During the correction of the trend, trade in the opposite direction of the trend until the first Fibonacci Ratio, i.e. 38.20% is reached.

In order to test the principles refined from the Wave Principle and the effectiveness of the trading rules developed thereon, a simulation model was built. The whole population of the closing prices of the 7,386 trading days since 4 January 1971 was applied on it.

The result nevertheless is far from satisfactory. Although the refined Wave Principle can, to certain extent, be verified, the trading result of the trading model is not good enough. One big disadvantage is its inflexibility. When the trading rules are strictly followed, there is always the lagging problem, where most deals made under the model could be closed before the profit vanished. In other words, the model cannot react to the change of price movement promptly. In this sense, the trading model is considered as inefficient. Notwithstanding the above, the model is quite safe that traders need not bear risk associated with all the ups and downs of the price movement.

However, the crucial factor of this model is still the existence of a long and stable trend with only mild corrections, which is totally uncontrollable to traders.

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1 Introduction

Speculation is always an attractive business, not just because of the tremendous profit potential it may bring, but also its simplicity. All a speculator needs to do is to deal with the market, no matter it is the market for stock, bonds or forex. He should try to understand, analyze and finally make use of the market to earn his living, but spend only the minimal effort on handling or managing people and following policies and procedures, which very often are not directly attributed to profit generation.

Speculation is basically involved only buying and selling "goods" and following the market movement so as to buy low and sell high. As goods being traded are standardized, there should not be any worry about the quality of goods. Also, as the market is large and efficient enough, no one may control the pricing or conduct any unfair deals.

Nevertheless, speculation is a zero-sum game. If you make profits, you make profits out of other market participants who do business with you but incur losses, and vice versa. As a result, the key to be a successful speculator is to acquaint with the ability to "predict" the market movement in advance of others. This would never be an easy task, however. While some speculators make decision based on their own intuition, most rely on more objective tools or models. These models can either be very simple or highly sophisticated. They may take into account factors of economics, psychology, astrology, statistics and/or complicated mathematical calculations.

After all, the objective of this project is to develop a model of our own, which can help to make consistent profits from the forex market via speculation.

1. 1 Background

Nowadays, there are 2 main schools of thoughts in predicting the market movements, namely *the fundamental analysis* and *the technical analysis*. Generally speaking, *fundamental analysis* takes into account of all current factors, which are considered to have direct bearings on the market, to project the future market movements. Such factors may include demand and supply, interest rate, inflation and many other economic indicators. The projection may make use of some statistical tools like regression analysis and alike.

Fundamental analysts will not consider historical prices as one of the relevant factors however. According to the Efficient Market Hypothesis, historical prices have no impact on future price movements because the historical prices should have fully reflected all relevant historical factors at that moment. Subsequent price changes must be due to new factors input into the market. Since when new factors will be generated and the extent of their impacts are so difficult, if not impossible, to predict, market movement is often viewed as random.

On the other hand, *technical analysis* focuses only on the historical prices. Technical analysts believe that there are recognizable patterns in the historical price movement and these patterns will repeat themselves again and again. Once these patterns are uncovered and followed, speculators would be able to predict the future price movements accurately. Common tools for technical analysis are graphs and charts, such as drawing trend lines, and simple mathematical calculations such as moving averages and RSI.

Nonetheless, there are always criticisms over the technical analysis. The main reason behind is perhaps its lack of theoretical support. Although some technical analysts argue that market movement should not occur in random manner but follow some

universal orders of the Nature, which can be seen in every aspects of our lives, it seems too remote and is yet to be proved scientifically. Despite the lack of theoretical support, the accuracy in predicting the market movement by and the brilliant trading result of some great analysts such as R N Elliott and W D Gann have brought the importance of technical analysis to a level that could not simply be ignored.

To some people, technical analysis is more advantageous than fundamental analysis not only because of the accuracy but also its simplicity and objectivity. In order to be accurate or at least persuasive, fundamental analysis requires large volume of raw data, complicated calculation and, usually, many subjective judgments, for example, as to how the market will react to certain matters. Yet, the prediction is subject to change by any contingency.

In fact, even the Efficient Market Hypothesis has not disproved the technical analysis. What the proof of the Efficient Market Hypothesis has shown is that the rate of price change in previous days does not impact the rate of price change in the future. But, even the simplest form of technical analysis does not assert that the relationship of price changes between previous days and present days is simply a direct proportion. While technical analysis admits there are ups and downs in price level, the ups and downs are in recognizable patterns. However, it is so hard, at least for the time being, to express these patterns into simple mathematical equations and that may be why the validity of technical analysis cannot been proved theoretically so far.

To sum up, this project will adopt technical analysis to develop a trading model. We are biased to technical analysis because of its simplicity and objectivity. Despite the lack of a sound theoretical proof, we believe the secret of the Universe, which supports the technical analysis, will be discovered eventually. By now, we hope, if our trading

model can be proved successful, we can help strengthen the confidence of technical analysis.

2. Methodology

Amid the world of technical analysis, there are various techniques such as the Gann Angles, the Elliott Wave Principle, the Spiral Calendar and the Japanese Candlestick Charting Techniques. This project will concentrate on the Elliott Wave Principle (the "Wave Principle"). This is because the Wave Principle is considered one of the most comprehensive and widely adopted techniques. Moreover, since its first launch to the speculation profession, it has stood the test of time over decades.

However, not all the details of the Wave Principle will be adopted. Otherwise, the model to be developed will be extremely complicated and difficult, if not too difficult. As such, only those parts which can be easily generalized in mathematical equation, and be tested, are adopted. For those parts which are outside our scope, we should hold any investment decision. Hopefully, with a simpler equation and lower frequency of investment decisions, deals made will be of higher quality and still be able to bring in remarkable returns.

Nevertheless, there are some limitations of this project as follows.

1. We will concentrate our study and testing on forex market only, say the JPY/USD market because we believe different markets have different "patterns".
2. We will not consider the financial arrangement for making a deal so that the interest rate differential between JPY and USD, the margin requirement and the related ruin risk to be borne will be ignored. It is considered that such a simplification would not affect the core of our model.
3. Similarly, we will not consider other procedural matters such as settlement and commission. These should not affect the core of our model either.

4. Standard contract size of JPY1,000,000 will be adopted. No multiple contracts can be held at one time. This is to avoid manipulation but to test the long-term profitability of our model.
5. Investment decisions can only be made once daily and only the opening price can be used for the deal. The closing price will however be input into our model for generating next day's investment decision.

2. 1 Approach

One basic market phenomenon Elliott Wave Principle adopts to predict future price movement is that, after a prolonged price increase (or decrease), there will always be a correction in the opposite direction. Such a correction will usually reach about 38.2% of the price increase preceding this correction.

Based on this belief, we may derive that within a particular period of time, say the period during which the prolonged price increase (or decrease) takes place, there should be a direct correlation between the price and time. In other words, as time increases, price increases (or decreases) in direct proportion. The first part of our study is to test, by simple linear regression, whether this assertion is correct.

Since the time period as prescribed above is not unlimited, as time passes a particular point in time when the 'trend' ends, the correlation mentioned above will not hold any more. However, according to Elliott Wave Principle, a correction in the opposite direction will take place. This correction may represent another period of time where a new correlation between the price and time takes place. The second part of our study is to test whether, after the correlation measured in the first part started to deviate from its original equation, a new correlation in the opposite direction takes place.

Nevertheless, there is a lot of variation in corrections. They may not simply take the form of simple linear regression. Despite this, Elliott Wave Principle suggests another prediction. The amplitude of the correction will usually follows Fibonaci ratio, namely, 38.2%, 50% and 61.8%, etc. As such, the third part of our study is to test whether this assertion about correction holds.

Suppose the results of test on 3 hypothesis above are good enough, some trading methods can be developed. First, if a simple correlation between price and time can be identified within a period of time, trade along this trend until the correlation is broken down (its confidence level falls below an acceptable level). Besides, when the correlation identified before is broken down but a new correlation in the opposite direction developed, trade in that opposite direction until the correlation is broken down again. Furthermore, even though the new correlation in the opposite direction cannot be identified, trade in that opposite direction until the correction reaches 38.2% of the amplitude of the major price increase (or decrease) preceding that correction.

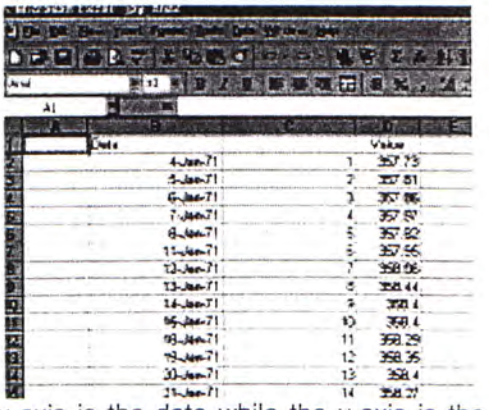
Having developed these trading methods, we may finally test whether they are effective and profitable by feeding historical and/or real time data.

2.2 Model automation tool

In order to make it feasible to apply our model to the actual situation where data points of over tens of thousand might have to be reckoned in order to identify a trend using an objective means i.e. calculation (regression), an efficiently automated trend identification process has to be established. We have chosen Visual Basic (Macro function) provided by Microsoft Excel as our tool to formulate the automation process.

2.2.1 Data

To identify a simple trend, we need to run a simple regression. Such simple regression requires two sets of data, the x-axis and the y-axis. The



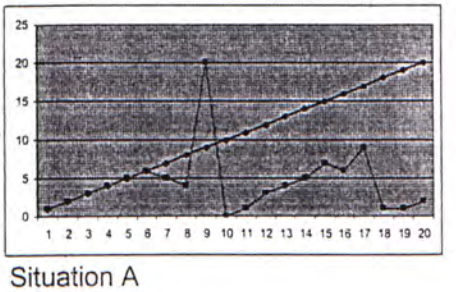
x-axis is the date while the y-axis is the Yen rate (equivalent to 1USD). Data are arranged in columns as depicted in graph 1.

Graph 1

For the purpose of running a regression, the dates have been converted into number in sequential order.

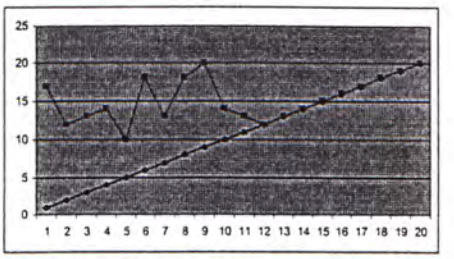
2.2.2 Trend identification by Regression

First, we select a reference point from which we would like to establish an "observable" trend with high confidence level(a relatively big R square value). We will first include the 500 data points to do the first trial of regression. Data points of less than 500 (~2 calendar years period) would not be considered long enough as a trend*. Perhaps, we will be running into two types of situation.



Situation A

Situation A is where the points close to the reference point align very nice with the reference point (point "0" as indicated in the graph) that it fits into an obvious trend, however, as the sample size grows bigger, such trend becomes non-existing.



Situation B

Situation B is where the points close to the reference point do not align with the reference point (point "0" as indicated in the graph) that it does not fit into an obvious trend, however, as the sample size grows bigger, such trend forms gradually.

Programs designed to recognize trends from situation A and situation B should be different. Macro 1 (exhibit 1) was designed to look for trend emerged under situation B condition. First, we define the minimum sample size to start with the regression process. Sample size will be increased by a magnitude of a week period (5 days or 65 days, please also refer to the chapter 4, Trade Model) until the regression result of the sample gives a confidence level of high enough level say, r-square of 0.9. Then the program will stop with the range of the sample being highlighted.

```
Sub Macro1()
'
' Macro1 Macro
'
Dim topLeft As Object
Dim samplesize As Integer
Dim a As Integer
Set topLeft = ActiveCell
   For samplesize = 500 To 999
   Application.Run "ATPVBAEN.XLA!Regress", ActiveSheet.Range(topLeft.Offset(0, 1), topLeft.Offset(-
samplesize, 1)), _
      ActiveSheet.Range(topLeft, topLeft.Offset(-samplesize, 0)), False, False, , "", False, False, False _
      , False, , Faise
      If ActiveSheet.Range("B5").Value < 0.9 Then
      a = samplesize
      samplesize = 999
      Else
      End If
   Worksheets("Sheet1").Select
   samplesize = samplesize + 5
   Next samplesize
   Range(topLeft, topLeft.Offset(-a, 1)).Select
End Sub
```

Exhibit 1

Macro 2 (exhibit 2) was designed to look for trend emerged under situation A condition. First, we define the minimum sample size to start with the regression process. Sample size will be increased by a magnitude of a week period (5 days or 65 days please also refer to Chapter 4, Trading Model) until the regression result of the sample no longer gives a confidence level of high enough level say, r-square of 0.9. Then the program will stop with the range of the sample being highlighted.

```
Sub Macro2()
'
' Macro2 Macro
'
Dim topLeft As Object
Dim samplesize As Integer
Dim a As Integer
Set topLeft = ActiveCell
   For samplesize = 65 To 999
   Application.Run "ATPVBAEN.XLA!Regress", ActiveSheet.Range(topLeft.Offset(0, 1), topLeft.Offset(-samplesize,
1)), _
      ActiveSheet.Range(topLeft, topLeft.Offset(-samplesize, 0)), False, False, , "", False, False, False _
      , False, , False
      If ActiveSheet.Range("B5").Value > 0.9 Then
      a = samplesize
      samplesize = 999
      Else
      End If
   Worksheets("Sheet1").Select
   samplesize = samplesize + 5
   Next samplesize
   Range(topLeft, topLeft.Offset(-a, 1)).Select
End Sub
```

Exhibit 2

Another two macros, namely Macro3 and Macro4 were designed to help further identify trends from the mass data pool. The main difference between Macro3 or Macro 4 and Macro 1 or Macro 2 is that the sample size is expanding forward for the former while the sample size is

```
Sub Macro3()
'
' Macro3 Macro
'
Dim topLeft As Object
Dim samplesize As Integer
Dim a As Integer
Set topLeft = ActiveCell
   For samplesize = 156 To 999  ' 156 is the manually input this case is 2107-1951
   Application.Run "ATPVBAEN.XLA!Regress", ActiveSheet.Range(topLeft.Offset(0, 1), topLeft.Offset(samplesize, 1)),
_
      ActiveSheet.Range(topLeft, topLeft.Offset(samplesize, 0)), False, False, , "", False, False, False _
      , False, , False
      If ActiveSheet.Range("B5").Value < 0.9 Then
      a = samplesize
      samplesize = 999
      Else
      End If
   Worksheets("Sheet1").Select
   samplesize = samplesize + 5
   Next samplesize
   Range(topLeft, topLeft.Offset(a, 1)).Select
End Sub
```

Exhibit 3

expanding backward. The objective of Macro 1 and Macro 2 is to find trends from historical data. The objective of Macro 3 and 4 is to detect any correction or trend derailment. Of course, in case of real application of the model, automation to detect correction or derailment is not necessary because one will simply check the trend with everyday need data point fed day by day. In our case, in order to demonstrate the viability of our model by using historical data, automation is needed so as to speed up the validation demonstration.

Macro 3's function is to detect if the trend (identified by either Macro 1 or 2 with historical data points) has been derailed or not as the time goes by. (Exhibit 3) Macro 4's function is to detect if another new trend (with size of at least 30 data points or 6 weeks data) has formed or not. (Exhibit 4)

```
Sub Macro4()
'
' Macro4 Macro
'
Dim topLeft As Object
Dim samplesize As Integer
Dim a As Integer
Set topLeft = ActiveCell
    For samplesize = 30 To 999
    Application.Run "ATPVBAEN.XLA!Regress", ActiveSheet.Range(topLeft.Offset(0, 1), topLeft.Offset(samplesize, 1)),
_
      ActiveSheet.Range(topLeft, topLeft.Offset(samplesize, 0)), False, False, , "", False, False, False _
      , False, , False
      If ActiveSheet.Range("B5").Value >= 0.9 Then
      a = samplesize
      samplesize = 999
      Else
      End If
    Worksheets("Sheet1").Select
    samplesize = samplesize + 5
    Next samplesize
    Range(topLeft, topLeft.Offset(a, 1)).Select
End Sub
```

Exhibit 4

2.2.3 Programming variables

A total of 3 variables are used in all four macro programming modules. These are,

topLeft,

samplesize and

a

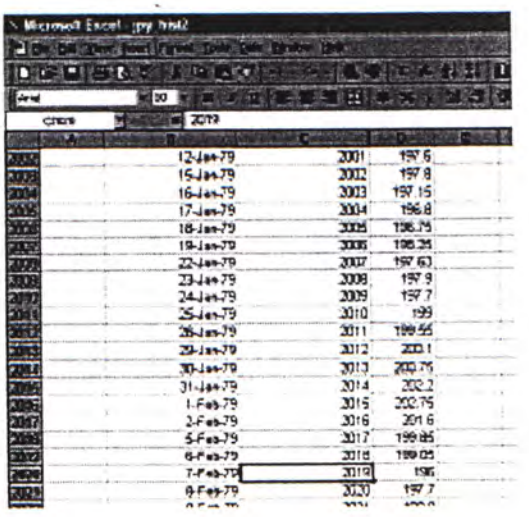
The variable topLeft is the position of the cursor pointer. The other two variables are of integer nature. The macro uses topLeft and the Offset parameter to define the data ranges for x-axis data (date in the form of no.) and y-axis data (yen price in the form of yen per USD) input for the regression run. The variable samplesize, as defined by its name, is the size of the sample range. The maximum sample size is set to be 999. It could be changed depends on the variance of maximum sample size acceptance on various belief. The variable a, is used to record the sample range when the regression loop stops because of condition has been met (either derailment occurs or good trends identified).

2.2.4 Execution

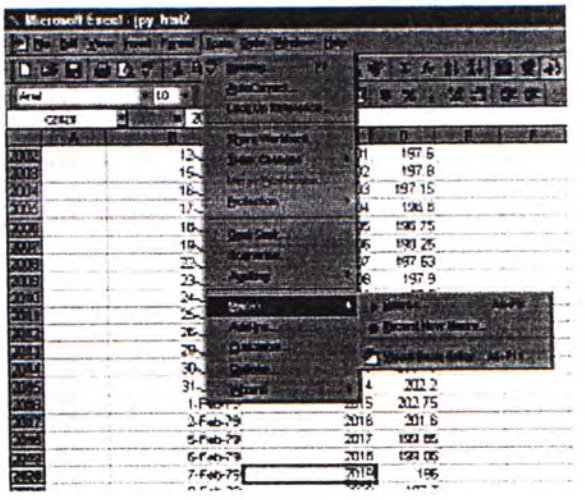
Open the excel data sheet file. When prompted by a dialogue box asking whether to enable macros, select enable macros.

Historical trend identification

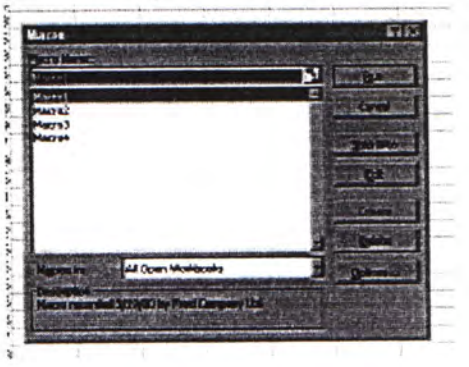
1. Place the cursor on the cell which contains date from where you want to start identify a trend from the historical data being included backward.



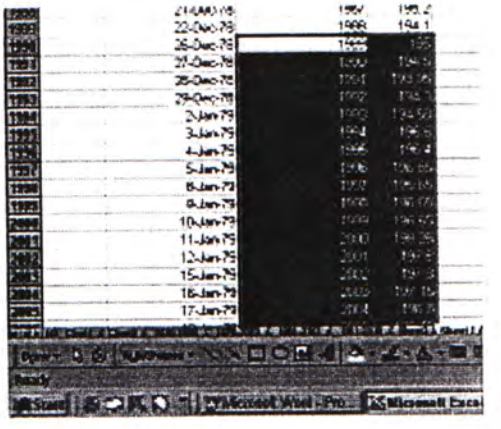
2. Choose Macro from the pull down menu.



3. Choose Macro 1 or Macro 2 depends of situation.



4. Macro stops when condition matched. Range would be identified. A



trend is identified.

3. Literature Review

The "Elliott Wave Theory" (EWT) is the fundamental of the model developed in this project which build entirely on its strong belief in trends and correction The Wave Principle is a detailed description of how markets behave. The swinging psychological status of the mass investor from pessimism to optimism and back in a natural sequence creates specific patterns in price movement which has been described systematically by the wave principle.[5]

The Elliott Wave Principle was developed by R.N. Elliott who published his work in the 1930s. The theory had not been widely used or caught serious attention until the 70s when R. R. Prechter published a book, "Elliott Wave Principle – Key to Stock Market Profits' which was a major consolidation of Elliott's work.

One of the Elliott Wave Principle's main believes is that investors are strongly induced to adopt the feelings and convictions of the group. The tendency toward dependence is virtually impulsive. As a result, market trends are steered not by the rational decisions of individual minds but by the peculiar collective sensibilities of the herd.[5] The Principle further describes patterns of these collective behaviour in the markets. The description reveals patterns of swings from pessimism to optimism and back in a natural sequence. The swings are not straight up or straight down but is in repetitive wave patterns. EWT captured this repetitive pattern as a wave cycle which should comprise of a five-wave advance and a three-wave decline sequence. A completion of one wave cycle will be followed by the beginning of another. The entire sequence is illustrated in Fig. 1.

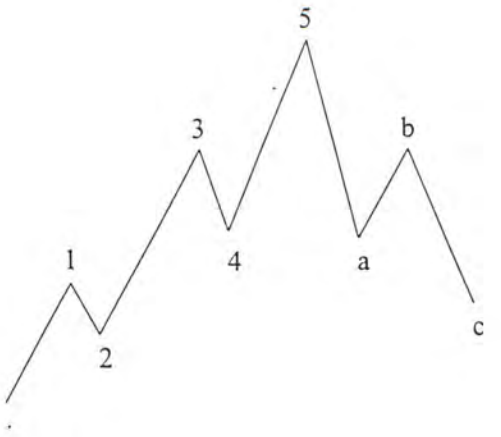


Fig. 1

Waves 1, 3 and 5 are known as the impulse waves while waves 2 and 4 are called the corrective waves. Wave 2 is the corrective wave for wave 1. Wave 4 corrects wave 3. The entire impulsive sequence, waves 1 to 5 is corrected by waves sequence denoted as wave a-b-c.

No identical wave patterns could exist at different time periods. This is because the events affecting the market will not be exactly the same as before. Therefore, waves will have different lengths of cycle and magnitudes.

A short wave cycle will complete in a few hours whilst a long wave cycle can span over several years. Nonetheless, according to EWT, the major pattern of any wave cycle will not change even with different lifetime. Having said that, it would not be difficult to understand that each wave sequence could always to be further composed of smaller wave components as illustrated in Fig. 2.

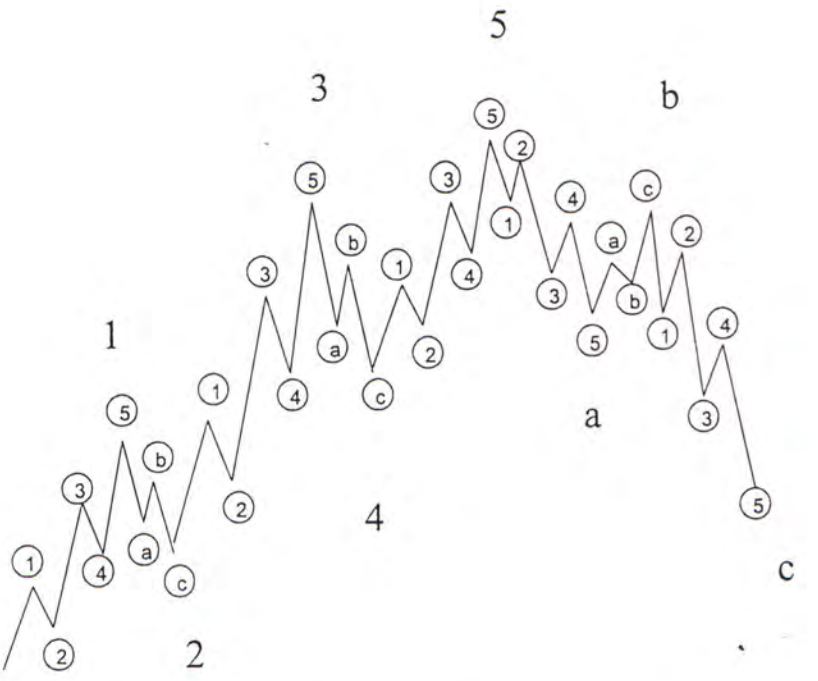


Fig. 2.

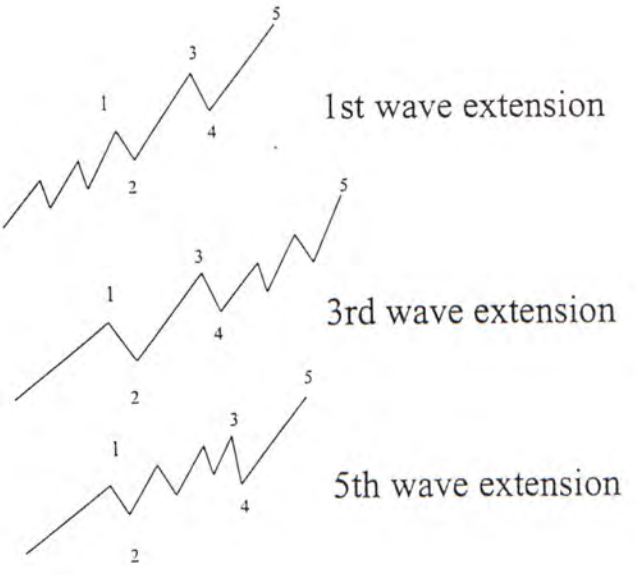
In other words, a wave cycle could actually consists of many subwaves. Similarly, subwaves could be further broken down into subwaves of another level downward. Thus, it is necessary to have some objective rules so as to make legitimate wave counting among complicated waves pattern.

(1) The correction wave 2 cannot trace back to a level lower than the commencing point of impulse wave 1.

(2) Among all impulse waves 1, 3 and 5, wave 3 cannot be the one with the shortest time span.

(3) Similar to rule no. 1, corrective wave 4 cannot trace back to a level lower than the ending point of impulse wave 1.

After examining the basic wave form, based on Elliot Wave Principle there are 3 variations of wave forms for the impulse waves namely extensions, 5th-wave failures and diagonal triangles. All are denoted in Fig. 3



In addition to the belief in trend – impulse and correction combo as illustrated in the EWT, the model developed in this project sets its fundamental on another belief of EWT, the Fibonacci Ratio. According to EWT as pointed out by Prechter, the length of wave 5 and the total 'displacement' from the starting point of wave 1 and ending point of wave 3 consists a Fibonacci ratio. Also, the length of correction waves (retracing extent) and its preceding impulse waves consists a Fibonacci ratio. The latter is particularly important to the model being studied in this project.

4. Trading Model

4.1 2 PREMISES

There are two underlying assumptions throughout our project. First, there is a linear correlation, at least in the short-term, between Price and Time. In our case, Price refers to the exchange rate of JPY/USD while Time refers to the number of days since 4 January 1971, which was the first date we can obtain market data for JPY/USD through Bloomberg. Number of days is used instead of the actual dates because distortion, which may be caused by the dates skipped in weekend and/or public

holidays, is to be avoided. Mathematically, this assumption can be expressed as follows, in the context of linear regression.

$$P = a + bT$$

where P = Price, the dependent variable

T = Time, the independent variable

a, b = constants

The second assumption of this project is, whenever a trend, as shown by the above assumption, is broken, there is always a correction in the opposite direction to the extent of at least 38.20% in amplitude of that trend. 38.2% is one of the most widely used Fibonacci Ratios, which bears the smallest value. Using the smallest value as the minimum correction requirement can increase the chances of success, and therefore the profitability of our deals.

4.2 TRADING RULES

Based on the above two assumptions, some trading rules can be developed.

1. As long as a trend can be identified (say, a linear regression with R^2>90%), trade along this trend until it is broken (say, a linear regression with R^2<90%).
2. Whenever a trend is broken, trade in the opposite direction to the trend until 38.20% of the amplitude of that trend is reached.
3. Do nothing but wait for the next trend, and then repeat Rules 1 & 2.

4.3 THE IMPLEMENTATION OF THE TRADING MODEL AND ITS TESTING

The premises and the trading rules can be implemented and tested by the following steps. (please also refer to part 2. 1 Process automation)

Step 1: Identify Trend

For a given date, do the regression exercise on a sample of data commencing from that date and thereon backward expanding successively to determine when the minimum period, which satisfies the condition of R^2>90%, is obtained, if any. If no such period can be found, repeat this exercise over with a latter date until R^2>90% is reached.

Do the regression exercise with data ranging from a given date to backward dates is to simulate the reality that a technical analyst has to look hindsight to see when a trend has formed to-date from the past.

Once such a period with R^2>90% can be found, a trend is identified.

Step 2: Determine when the Trend ends and Correction starts

Start from the first day of the period identified in step 1 above. Do the regression exercise with market data from this very first day and thereon forward successively to see when the R^2 will first fall below 90%.

Once the R^2 falls below 90%, a trend is said to have broken and correction started.

The end of the trend (and therefore the start of its respective correction) is however not lying exactly at the end point of the period when the R^2 first falls below 90%, but at the maximum or minimum point (i.e. the turning point) of the actual data within the period. This should be determined visually through chart plotting.

Step 3: Determine when the Correction ends

Repeat step 1 from the end of the trend just determined. Suppose a new trend in the same direction is eventually identified, the maximum or minimum point (as the case may be) between these two trends (old and new) should be the end of the correction of the first trend. This can be determined visually too.

Unlike the end of a impulse trend, the end of a correction cannot be determined in a way as suggested in step 2. This is because a correction is usually more complex and may not even constitute a regression with R^2>90%. After all, our assumption related to correction focuses on its amplitude rather than on its correlation with Time. As such, a correction can be considered as merely some forms of interruptions between two main trends.

Step 4: Determine whether there is correlation during Corrections

Before a new trend with the same propensity as the previous trend identified in step 2 can be found, any trend identified in the opposite direction is regarded as correction. In some cases there are also correlation between Price and Time during correction in these trends.

As mentioned, corrections are usually very complex. They may or may not comprise trends but some irregular patterns. In case trends can be identified in corrections, it may imply more trading opportunities.

Step 5: Make deals and evaluate Trading Results

Make deals based on information generated in above steps. Evaluate the trading result afterwards.

1. open a position along the trend when a trend is confirmed.

2. Close that position and immediately open a second position in the opposite side when the trend is confirmed ended.
3. Close the second position when the target of 38.20% correction is reached.

A trader should note that no one is able to open and close a position precisely at when a trend starts or ends simply based on technical analysis (unless he can control the market or possess some kind of insider information). He has to wait for the historic price movement to confirm the formation and termination of a trend. Thus, there may be a lagging problem, that is, opening a position when a trend has already ended and/or unable to close the position before a substantial portion of the trend is corrected or reversed, which will reduce profit or even induce loss.

Step 6: Start Over

From step 3, a second trend has been identified. With this newly identified trend, proceed to step 2 and start the whole process again.

While this model can be used continuously (provided that the trading result is satisfactory), it can also be used at any time if a trader wants to start speculation (or stop for a while but resume trading later), and even to apply on products other than JPY/USD. No too much preparation is required. The key is, there should always be a correlation between the Price of the product and the Time.

4.4 The Test

For the purpose of this Project however, trading is assumed to start at 500th trading day since 4 January 1971 (which was the first date we can obtain market data for JPY/USD) and continue till 7,386th trading day (which was the latest market data we could have). Going through all these 7,386 trading days data, we can simulate a

speculator's trading experience and identify all trends and corrections (and therefore all trading opportunities) identifiable under our trading model. These trends and corrections and the trading opportunities can then be used to test the validity of our 2 premises and the effectiveness of our trading model and the associated profitability from its application.

4.5 Some Arbitrary Inputs and Limitations

Before actually performing the Test, some criteria are to be set arbitrarily.

First, as mentioned above, trading is to start at 500th trading day. Assuming 5 trading days per week and 65 trading days per quarter, 500 trading days equal approximately 2 calendar years. These 2 years are allowed before actual trading because sufficient market data has to be accumulated beforehand for performing regression exercises to determine the Grand Trend. (For a discussion of the Grand Trend, please refer to the "Preliminary Testing and the Grand Trend" below.)

The second input we have to set arbitrarily is the level of R^2, based on which we will decide whether a trend is formed, broken or not. At present, this acceptance level is set at 90%. This acceptance level cannot be set too low because it may lead to a lot of "false alarms" i.e. identifying "trends" which are not real trends. But, if this is set too high, it will increase the difficulty in identifying trends and, thus, reduce trading opportunities. Although it is claimed that trends identified with a higher R^2 are of "higher quality", they cannot tolerate even minor corrections. All these mean that they are in fact of limited practical uses. Nevertheless, whether the current level of 90% is the best level is yet to be proved.

Besides R^2, another criterion is set for trend identification is the minimum length of period for a trend. In this Project, it is set at 65 trading days or about 3 calendar months. Similar to R^2, it can neither be too high nor too low. The current level used in the model is set arbitrarily. Nevertheless, unlike R^2, a higher minimum lasting period can tolerate correction to a greater extent. This will however result in a more severe lagging problem, as mentioned in step 5 of the trading model part discussed.

There are two other minor arbitrary inputs, namely, the frequency of data fed and the maximum length of lasting period of a trend. The frequency of data fed refers to how frequent to input new market data for the regression. Due to limited resources, it is currently set at 5 trading days (or 1 week) if there is open deal and 65 trading days (or 3 months) if there is not. Nonetheless, it can be regarded as a simulation to amateur speculation.

On the other hand, the maximum lasting period of a trend is set merely as a mean to avoid data overloading. Currently, it is set at 1000 trading days (or about 4 calendar years).

4.6 Preliminary Testing and the Grand Trend

As mentioned above, 500 market data have been accumulated before actual trading. (Assuming trading started at 501th trading date since 1971/1/4) These data were used for regression exercises to determine the Grand Trend.

The Grand Trend refers to the general trend, if any, of the product under speculation across time. The existence of the Grand Trend is desirable to our trading model. If it can be proved with a satisfactorily high level of R^2, it can provide a preliminary evidence for the validity of the linear correlation between Price and Time.

Apart from that, it helps to distinguish *genuine trends* from pseudo *trends*. By the term of genuine trends, we mean they are real trends and can be described as impulses or thrusts, which usually lead to advancement to a new high level of price. By the term of pseudo trends, however, we mean they are not real trends, but merely a portion of a correction to a genuine trend. Although they can show a regression result of R^2>90%, they are in the opposite direction to the Grand Trend (and therefore to the genuine trend) and may not constitute to advancement to a new high or low level of price.

As mentioned in step 3 and 4 of the trading model, corrections are always more complex than trends. For example, a correction may comprise some irregular patterns, several pseudo trends and/or even some genuine trends but a trend consists of mainly genuine trends. In order to reduce confusion, it is advisable to trade during correction, as stipulated in Rule 2 of the trading model, only trade when the correction is a correction to a genuine trend but not when a correction to a pseudo trend.

The first 500 market data show that the JPY/USD is decreasing from 357.73 to 301.66 with R^2=85.80%. Although R^2 cannot reach 90%, it does provide a preliminary evidence of the correlation between Price and Time and show the direction of the Grand Trend. In fact, such a preliminary result coincides with the overall result from a total of 7,386 market data, where R^2=86.15% and JPY/USD decreases from 357.73 to 109.23.

5. RESULT & ANALYSIS

Having gone through all those 7,386 trading days and made deals according to the trading model mentioned above, we are now going to analyze the results, which are summarized in Tables 1 & 2, and see whether there can be any improvement. For the ease of analysis, the results are classified into 2 types of deals. Table 1 covers all

deals made under Rule 1, which encompasses deals made along trends identified. Table 2, on the other hand, covers all deals made under Rule 2, which is composed of deals made on corrections to trends identified as those listed in Table 1.

5.1 Deals made along Trends Identified

First of all, it can be showed that there is correlation between Price and Time (with R^2>90% and lasts for more than 65 trading days). In other words, trends do exists at least for JPY/USD. In addition to the Grand Trend as identified in the Preliminary Testing, there are also some short-term trends. From Table I, we find that there are a total of 21 trends identified, which last for an aggregate of 3,938 trading days (or 53.32% of the whole trading period). Actual trading time is 1,001 trading days. Having excluded those periods for corrections, the coverage is considered reasonable. Despite the facts that the trends are discontinued and in opposite directions (10 decreasing and 11 increasing), together they form the Grand Trend (with corrections) and provide trading opportunities.

However, the trading result is far from satisfactory. A total loss of 25.24% was recorded. After looking into the deals one by one, it was found that the main reason was the lagging problem: Trends were confirmed right after it had actually ended (i.e. after the turning point); or, deals could not be closed before a significant correction.

Nevertheless, the returns of some profitable deals are tremendous, up to 15.91% per deal.

Some remedial measures are therefore recommended, trying to keep only those profitable deals and/or to limit maximum loss per deal. They are as follows.

First, do not trade when it is apparent that the turning point has already been passed. In practice, the boundary can be set at 1.00% from the maximum (or minimum, as the case may be) of the trend so identified at that moment. Unless the price level, as at when the trend is confirmed, remains within the safety boundary, do not make any deal.

Trade only along the genuine trends but not the pseudo ones. From our trading results, it was found that most significant losses accrued from pseudo trends. The reason might be those pseudo trends were in fact parts of a correction. Their movements were complex and radical. A sudden change in direction would end the pseudo trend instantly and caused a big loss.

Thirdly, apply cut-loss limit, say 1.00%. Provided that the adverse price change is not very radical, this would be an extremely effective measure to limit loss. Nevertheless, position may be re-opened if the price level resumes back to the safety zone.

Finally, if the lagging problem is considered as a structured problem, some arbitrary input set previously for this trading model may have to be changed. One possible alternative is to increase the acceptance level criterion, R^2 for trend identification, with a corresponding decrease in the minimum lasting period for a trend. This aims at reducing the effect of lagging problem while, at the same time, not necessarily increasing 'false alarms' too much. The result has yet to be proved, however.

Should the first 3 remedial measures have been implemented beforehand, the trading results of the deals made along the trends would be much better.

Even if we have taken out all deals which were made during pseudo trends, there would still be some losing deals. These losing deals were not real losing deals if they

were viewed as a part of a bigger trend. For example, T2 and T3 together formed a bigger trend. Notwithstanding the fact that the deal made for T2 turned out to be a losing deal, the bigger trend formed by T2 and T3 made an admirable profit. The situation was similar to T7, T8 and T9. Together, they formed a bigger trend and made a net profit.

With the graphs that follow, we may find that the 9 genuine trends (T4 is in fact a part of the correction to the bigger trend formed by T2 and T3 together) can be consolidated into 5 dominant trends. All of them represent strong and endurable advancement to a new high level of price. The short breaks between the smaller trends, which may induce temporary losses, are merely minor corrections. As a result, in the context of these bigger trends, all deals made for genuine trends are profitable except T1 and T10.

For T1, the opportunities to make profit during the trend are concealed in the first 500 market data, where dealing is not allowed. For T10, the bigger trend associated to it has not been fully uncovered.

Despite the argument above, the result was still unsatisfactory. This was because, first, the total number of deals made was too little and, second, the return of all these deals was too trivial.

With a total of 7,386 trading days (about 30 calendar years), only about 10 deals could be made, with a return of at most 33.81% (assume only profitable deals were made without margin financing). The result was not very appealing. The result would have been even better if a position had been opened immediately as at when the Grand Trend was confirmed at the 500th trading day at 301.66 and closed at the 7,386th

trading day at 109.23. If a trader was willing to bear all the risks associated with the ups and downs during this period, he might be able to get a return of 176.17% in total.

After all, it can be concluded that deals made along genuine trends are profitable but rather inefficient, especially when a speculator wants assurance as to the trend formation by historic price movement. It seems the pre-requisite to make profit along a trend is the existence of a long and stable trend with only mild corrections, which is however totally uncontrollable by speculators.

5.2 Pseudo Trends Identified during Corrections of Trends

As discussed earlier, it is not advisable to trade along the pseudo trends because trading experience told us that they are not as reliable as the genuine trends. Corrections are more complex and changes can be very radical.

Moreover, not all corrections to genuine trends comprise pseudo trends, even in the context of those bigger trends. For example, although the correction to the bigger trend formed by T5 and T6 is quite significant, no pseudo trend could be identified.

In short, the pattern of corrections is always unexpected and radical enough to trap the model user. As a result, the safest way to deal with corrections is to trade against their amplitude rather than their patterns.

5.3 Deals made during Corrections of Trends

Now, we are going to discuss the result from deals made during corrections of trends. First, it seems that our second assumption regarding the extent of correction did not always hold. The corrections of 3 trends (out of a total of 10) did not go back to at least 38.20% of the amplitude of their respective preceding trends. This led to a net trading

loss of about –25.39% from those deals made under Rule 2 - deals made for capturing the corrections of the preceding trends. From Table 2, it was found that these 3 failing deals accounted for a loss of –52.56%. In other words, other deals had made a gross profit of 27.17%.

The total trading loss could have been greatly reduced or even turned to a trading profit if a cut-loss limit of 1.00% as recommended above had been strictly complied with. In fact, the trading result as shown in Table 2 is based on the assumption that corrections are confirmed finished (and therefore corresponding deals closed even though 38.20% has not been reached) if and only if a new genuine trend is confirmed. However, this assumption is not pragmatic and the deals made for those 3 failing corrections should have already been cut when the minimum points of their respective preceding trends passed again, but not until the next trend was confirmed.

As a simulation of actual trading, one may be interested in noting that the profit from the correction of T4 may not be crystallized because prior to the targeted 38.20% price level could be reached, a further minimum point from T4 had to be reached first. That was, a speculator might need to close the position under the cut-loss limit before taking the profit. Nonetheless, he might re-open the deal should the price level restore to the safety level.

As mentioned previously, the 9 genuine trends can be consolidated into 5 dominant trends. Within a dominant trend, there may be genuine trends with not long and endurable enough duration for us to make profits under our trading model, and there may be inadequate corrections which can restore the price level back to our minimum requirement of 38.20%. Notwithstanding these, they all imply that a bigger trend has not yet completed. If we take the dominant trend as a whole, neither of our assumptions nor the trading model fails.

In fact, alternatively, the failures at the smaller genuine trends could be viewed as new trading opportunities. Having noted these temporary failures, we could open a position along the genuine trend immediately. Suppose a bigger trend does exist, we could make additional profit by taking the advantage of the further advancement of price level without waiting for the confirmation of trend formation from historic price movement.

Back to Table 2, one more point can be noted. Despite the minimum correction requirement of 38.20%, the maximum profit per deal from these deals was merely 6.72%, from the correction of T1 which was much less than 38.20%. Again, this was resulted from the lagging problem. For deals made during corrections, it was not the case that a deal was to be opened (when a trend is confirmed broken) right after the 38.20% correction level was reached thus, the trading profitability was greatly reduced. In fact, the profit of 6.72% from the correction of T1 was exceptionally high already when compared to other deals where profits ranged merely from 0.85% to 4.64%. Such an outstanding performance was however due to the rapid price movement on the date when position was closed. If only the correction were more gentle, the profit should have been much lower. In addition, such a rapid price movement might not be always in the favorable direction.

Having examined the actual ratios of the correction's amplitude to the trend's (the "correction ratio"), one may find that the profit *missed* by our trading model was even higher. Excluding the 3 failing corrections as discussed above, the smallest correction ratio we had was 50.00%. As a result, closing the deals at the targeted level of 38.20% was too pessimistic and might mean an under-utilization of profitable opportunities.

Nevertheless, there seems impossible to recover these missing profits. As mentioned previously, the price movement during correction is rather complex and can be very

radical. As long as there is a sudden change in direction of the price movement, profit may evaporate instantly and big loss accrued even though trades are being made along a pseudo trend.

After all, it can be concluded that, similar to those deals made along trends identified, the trading result of deals made during corrections was not very appealing despite the fact that it was profitable. The main reason was the lagging problem. Besides, notwithstanding the potential profit behind the minimum correction ratio of 38.20, they could be too risky to take.

6. CONCLUSION

Having examined the trading results, though we may argue the 2 assumptions made for the trading model are valid, the trading model itself is not very appealing indeed. It cannot bring tremendous profit. One big advantage is, however, its relatively low level of risk associated. Without taking too much risk of bearing all the ups and downs of the price movement, this model is quite safe to amateur speculator. However, on top of that, the crucial factor is still the existence of a long and stable trend with only mild corrections, which is however totally uncontrollable.

6.1 Further Studies Recommended

Since this Project focused only on JPY/USD, similar testing on other products or currency pairs can also be done, especially to those products where a preliminary correlation between Price and Time can be found. This can help to prove whether our trading model is universally applicable.

On the other hand, since our trading model has adopted some arbitrary inputs, where their values are based on wild guess, changes to these values may have some impacts on the final trading outcome. Therefore, it is recommended that some inputs can be fine tuned to see whether optimal values exist. This is especially true for the acceptable value of R^2, the minimum lasting period of a trend and the frequency of data fee.

Finally, the assumption of linear correlation may not be the best correlation between Price and Time. It is apparent that there is some curvature in some trends. Thus, other forms of correlation can also be tested to see whether our trading result can be further enhanced.

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Deals made along Trends Identified

Ref	Name of the Trend	Trend (notes 3 & 4)					Confirmation of Trend (notes 1 & 2)					Same direction as the Grand Trend (Y/N)	Trading Result (%)	Graph	Remark
		Date			Value		Date			Value					
		From	To	Period	From	To	From	To	Period	From	To				
1	T1	12	540	529	358.35	254.45	621	721	101	259.4	280.11	Y	-7.39%	1	loss, trend already ended
2	T1C1	1087	1174	88	292.23	303.31	1191	1201	11	302.76	301.75	N	-0.33%	1	loss, trend already ended
3	T1C2	1102	1224	123	291.89	306.84	1256	1261	6	304.04	303.67	N	-0.12%	1	loss, trend already ended
4	T2	1477	1563	87	294.81	270.71	1581	1586	6	276.85	277.62	Y	-0.28%	2	loss, trend already ended
5	T3	1572	1951	380	278.01	177.05	1756	2041	286	241.85	208.65	Y	15.91%	2	profitable
6	T3C1	2017	2077	61	199.85	224.95	2081	2086	6	215.15	214.2	N	-0.44%	2	loss, trend already ended
7	T3C2	1982	2288	307	195.55	261.4	2276	2311	36	248.7	233.6	N	-6.46%	2	loss, due to radical correction
8	T4	2277	2339	63	248.92	215.75	2341	2351	11	217.2	217.9	Y	-0.32%	2	loss, trend already ended
9	T4C1	2502	2622	121	207.45	246.1	2601	2636	36	229.83	228.4	N	-0.63%	2	loss, due to time lag
10	T4C2	2732	2790	59	224.5	248.75	2796	2801	6	247.8	241.15	N	-2.76%	2	loss, trend already ended
11	T4C3	2692	2935	244	225.7	277.65	2926	2951	26	273	249.2	N	-9.55%	2	loss, due to radical correction
12	T4C4	3302	3366	65	225.1	246.95	3381	3386	6	244.08	241.05	N	-1.26%	2	loss, trend already ended
13	T4C5	3447	3510	64	243.65	262.8	3511	3531	21	262.65	256.65	N	-2.34%	2	loss, trend already ended
14	T5	3627	3907	281	238.5	152	3771	3946	176	180.7	162.82	Y	10.98%	3	profitable
15	T6	4167	4228	62	146.9	121.25	4231	4241	11	129.65	127.2	Y	1.93%	3	profitable
16	T7	5147	5271	125	137.93	123.2	5266	5291	26	126.8	128	Y	-0.94%	4	loss, due to time lag
17	T8	5337	5391	55	134.15	124.42	5401	5406	6	125.3	127.39	Y	-1.64%	4	loss, trend already ended
18	T9	5522	5634	113	125.29	105.09	5586	5661	76	113.55	108.15	Y	4.99%	4	profitable
19	T9C1	6157	6225	69	84.57	104.55	6221	6246	26	102.58	100.74	N	-1.83%	4	loss, due to time lag
20	T9C2	6102	6980	879	89.55	147.26	6936	7031	96	140.57	117.13	N	-20.01%	4	loss, due to radical correction
21	T10	7182	7344	163	124.32	101.45	7326	7351	26	102.88	105.79	Y	-2.75%	4	loss, due to time lag
			Total	3938				Total	1001			Total	-25.24%		

Notes:

1. For a given date, a trend, if any, is confirmed if a linear regression with R^2>90% can be found for a period of at least 65 working days (or 3 months), starting from that da
2. A trend is confirmed broken if R^2 of the trend identified above first falls below 90% when more upcoming trading days are included in the regression.
3. The starting point of a trend is the starting point of the period as confirmed by note 1 above.
4. The ending point of a trend is the minimum point (or the maximum point, as the case may be) of the trend identified above by notes 1 & 2.

Table 1

Deals made during Corrections of Trends

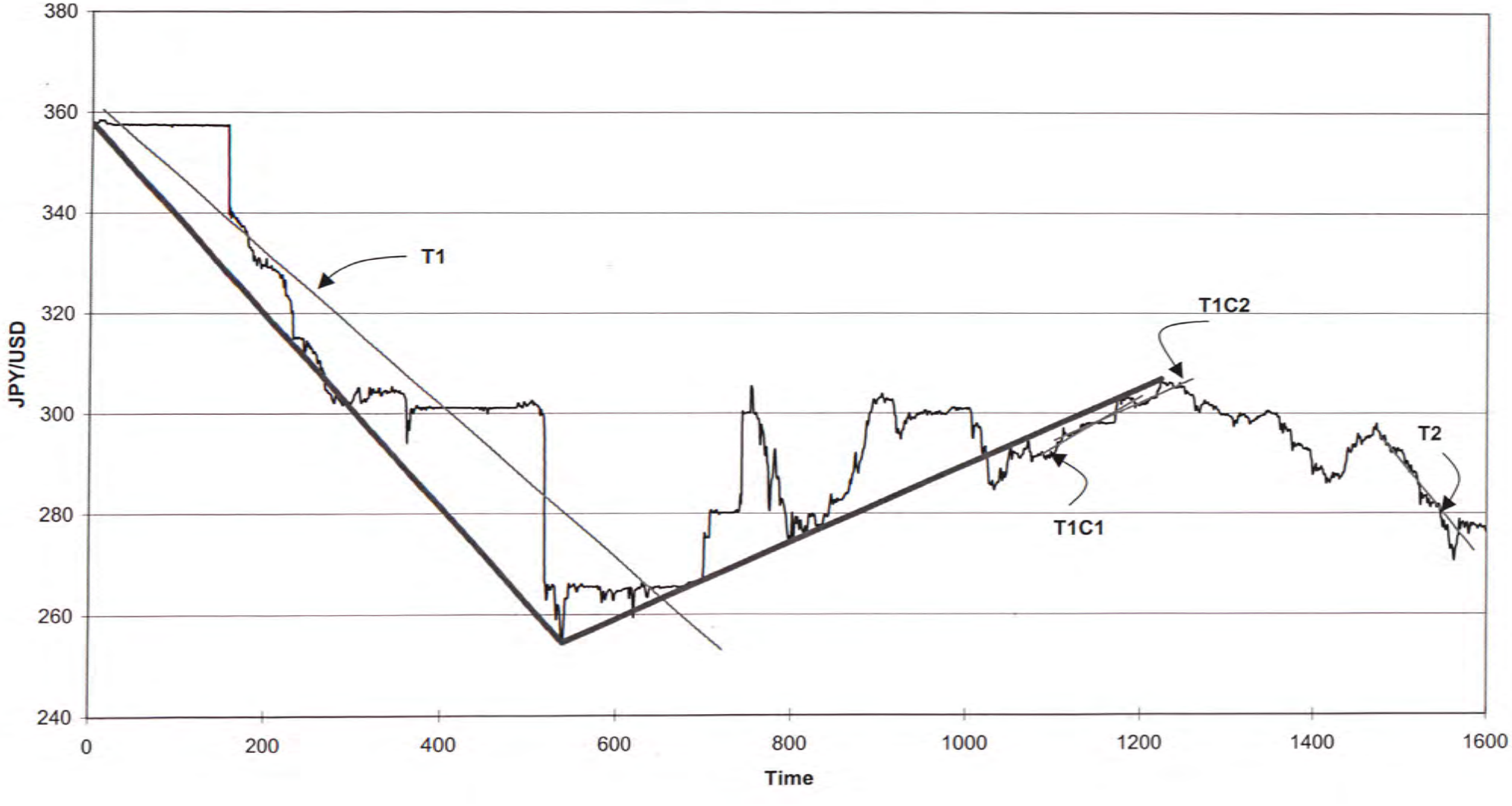
Ref	Name of the Trend	Trend (note 1)							Correction (notes 2 & 3)						Deals to be mad		Trading Result (%)	Graph	Remark
		Date		Value					Date		Value				Date				
		From	To	From	To	Amplitude	38.20%	Target Correction	From	To	From	To	Amplitude	Ratio to Trend	From	To			
1	T1	12	540	358.35	254.45	103.9	39.69	294.14	540	1224	254.45	306.84	52.39	50.42%	721	744	6.72%	1	radical correction
2	T2	1477	1563	294.81	270.71	24.1	9.21	279.92	1563	1569	270.71	278.78	8.07	33.49%	1586	1756	-14.79%	2	inadequate correction
3	T3	1572	1951	278.01	177.05	100.96	38.57	215.62	1951	2288	177.05	261.4	84.35	83.55%	2041	2063	3.29%	2	profitable
4	T4	2277	2339	248.92	215.75	33.17	12.67	228.42	2339	2935	215.75	277.65	61.9	186.61%	2351	2600	4.64%	2	may have cut loss
5	T5	3627	3907	238.5	152	86.5	33.04	185.04	3907	3939	152	164.5	12.5	14.45%	3946	4231	-25.58%	3	inadequate correction
6	T6	4167	4228	146.9	121.25	25.65	9.80	131.05	4228	4812	121.25	159.9	38.65	150.68%	4241	4257	3.01%	3	profitable
7	T7	5147	5271	137.93	123.2	14.73	5.63	128.83	5271	5339	123.2	134.53	11.33	76.92%	5291	5295	0.85%	4	profitable
8	T8	5337	5391	134.15	124.42	9.73	3.72	128.14	5391	5404	124.42	128.1	3.68	37.82%	5406	5586	-12.19%	4	inadequate correction
9	T9	5522	5634	125.29	105.09	20.2	7.72	112.81	5634	6980	105.09	147.26	42.17	208.76%	5661	5781	4.34%	4	profitable
10	T10	7182	7344	124.32	101.45	22.87	8.74	110.19	7344	N/A	101.45	N/A	N/A	N/A	7351	7377	4.31%	4	not yet completed
																	-25.39%		

Notes:

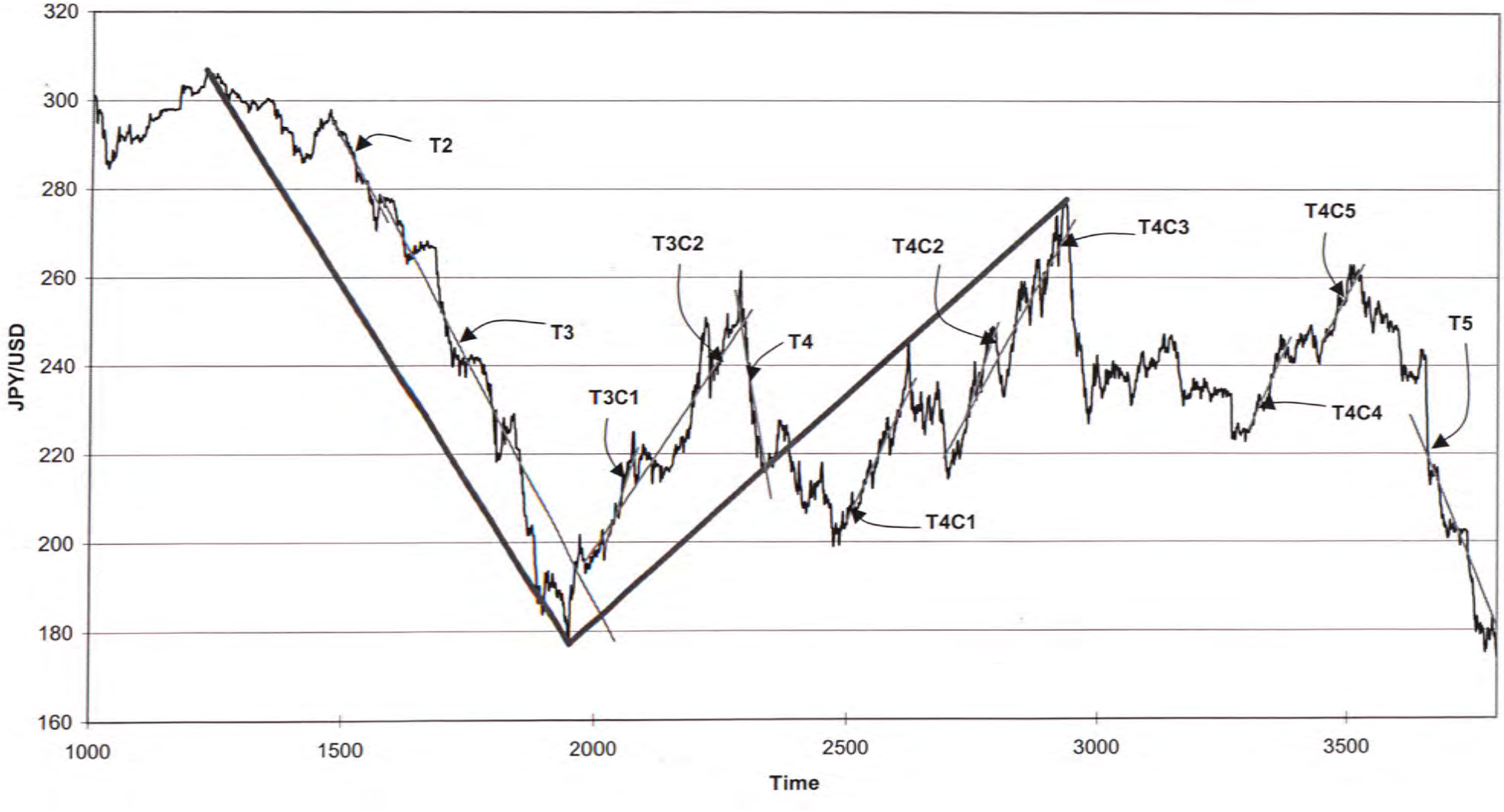
1. Please refer to Table 1 for Trend identification.
2. The starting point of a correction is the ending point of the preceding trend.
3. The ending point of a correction is the maximum point (or the minimum point, as the case may be) between the preceding trend and the next trend.
4. Position is opened when the preceding trend is confirmed broken. (Please refer to Table 1 for when the trends are confirmed broken.)
5. Position is closed when correction of 38.20% from the preceding trend's ending point is reached.

Table 2

Trend 1 : T1, T1C1, T1C2



Trend 2 : T2, T3, T3C1, T3C2, T4, T4C1, T4C2, T4C3, T4C4, T4C5

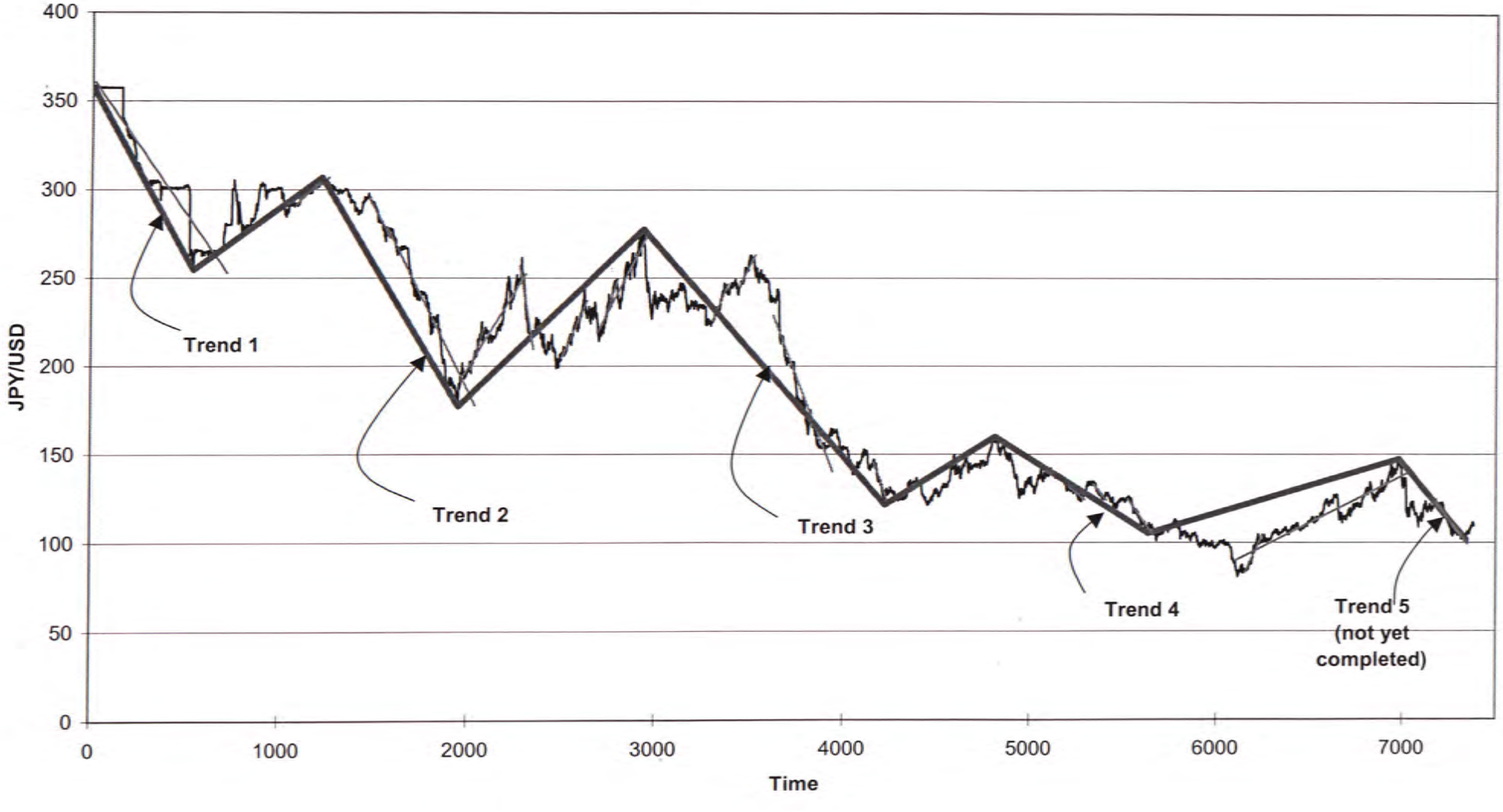


Trend 3 : T5, T6


300
280
260
240
220
200
180
160
140
120
100
JPY/USD
2500
3000
3500
4000
4500
5000
Time
T5
T6

Trend 4 : T7, T8, T9, T9C1, T9C2 & Trend 5 : T10 (not yet completed)

Overall Chart



JPY/USD Against Time with Line of Best Fit